SOUTH DAKOTA STATEWIDE FISHERIES SURVEY

2102-F21-R-42

Name: Lake Carthage **County**: Miner
Legal Description: T108R- R57W- Sec. 4-5, 8
Location from nearest town: ½ mile east of Carthage, SD

Dates of present survey: July 28-30, 2009 (netting), June 8, 2009 (electrofishing)
Dates of last survey: July 31-August 1, 2007 (netting), June 8, 2007

Primary Game Species	Other Species
Largemouth Bass	Northern Pike
Bluegill	Black Bullhead
Black Crappie	Yellow Perch
Channel Catfish	Carp
	White Sucker
	Walleye

PHYSICAL DATA

Surface area when full: 203 acres **Watershed area:** 94,574 acres
Maximum depth: 24 feet **Mean depth:** 8 feet
Volume: 1,550 acre-feet **Shoreline length:** 4 miles
Contour map available: Yes **Date prepared:** 1970
Lake elevation observed during the survey: 3 feet low
Beneficial use classification: (4) warmwater permanent fish propagation, (7) immersion recreation, (8) limited-contact recreation, (9) fish and wildlife propagation and stock watering.

Introduction

Lake Carthage was originally a 38-acre impoundment built on Redstone Creek by the Works Progress Administration (WPA) in 1936. It was named for the nearby town of Carthage. By the early 1960s, erosion from the watershed had silted in the lake, ruining the fishery and the dam and spillway needed repairs. In 1964, a new dam was built downstream that increased the size of the lake to 203 acres.

Ownership of Lake and Adjacent Lakeshore Properties

Lake Carthage is owned and managed by the South Dakota Department of Game, Fish and Parks (GFP). The majority of the lakeshore and surrounding land (430 acres) is owned by GFP. The remainder is privately owned.

Fishing Access

The Lake Carthage Recreation Area, located on the east side of the lake, contains a boat ramp with a dock, public toilet, swimming beach, picnic tables, and areas for primitive camping. There are many areas accessible to shore fishermen.

Field Observations of Water Quality and Aquatic Vegetation

The water in Lake Carthage was turbid with a Secchi depth of 41 cm (16 inches). Common cattail (*Typha spp.)* was plentiful in shallow areas and some sedges (*Carex spp.)* were also observed.

BIOLOGICAL DATA

Methods:

Lake Carthage was sampled on July 28-30, 2009 with ten overnight trap-net sets. The trap nets are constructed with 19-mm-bar-mesh (¾ in) netting, 0.9 m high x 1.5 m wide (3 ft high x 5 ft wide) frames and 18.3 m (60 ft) long leads. Two hours of nighttime electrofishing were done on June 8, 2009 to assess the largemouth bass population. Sampling locations are displayed in Figure 5.

Results and Discussion:

Trap Net Catch

Black bullheads (96.8%) were the most common species sampled in the trap nets followed by black crappie (1.3%) and common carp (0.6%). Bluegill, channel catfish, northern pike, white sucker, hybrid sunfish, and walleye were also sampled (Table 1 and 2).

Table 1. Total catch from ten overnight trap net sets at Lake Carthage, Miner County, July 28-30, 2009.

Species	Number	Percent	CPUE	80% C.I.	Mean CPUE*	PSD	RSP-P	Mean Wr
Black Bullhead	6,849	96.8	684.9	±268.2	793.5	1	0	85
Black Crappie	92	1.3	9.2	±4.7	11.8	18	1	112
Common Carp	39	0.6	3.9	±1.6	9.8	92	3	81
Bluegill	36	0.5	3.6	±3.2	18.2	61	0	109
Channel Catfish	26	0.4	2.6	±1.1	13.9	14	14	82
Northern Pike	15	0.2	1.5	±0.4	0.9	60	7	83
White Sucker	12	0.2	1.2	±0.6	9.3	100	70	109
Hybrid Sunfish	2	0.0	0.2	±0.3	0.7	--	--	--
Walleye	1	0.0	0.1	±0.1	0.7	--	--	--

* 5 years (1999, 2001, 2003, 2005, 2007)

Table 2. Catch per unit effort by length category for various fish species captured with trap nets in Lake Carthage July 28-30, 2009.

Species	Substock	Stock	S-Q	Q-P	P+	All sizes	80% C.I.
Black Bullhead	19.8	665.1	658.5	6.6	--	684.9	±268.2
Black Crappie	0.4	8.8	7.2	1.5	0.1	9.2	±4.7
Common Carp	--	3.9	0.3	3.5	0.1	3.9	±1.6
Bluegill	--	3.6	1.4	2.2	--	3.6	±3.2
Channel Catfish	1.9	0.7	0.6	--	0.1	2.6	±1.1
Northern Pike	--	1.5	0.6	0.8	0.1	1.5	±0.4
White Sucker	--	1.2	--	0.3	0.9	1.2	±0.6
Hybrid Sunfish*	--	--	--	--	--	0.2	±0.3
Walleye	--	0.1	--	--	0.1	0.1	±0.1

*No length categories established. Length categories can be found in Appendix A.

Largemouth Bass

Management objective: Maintain a largemouth bass fishery with an electrofishing CPH of at least 20 for stock length (≥20 cm, 8 in) and longer fish and a RSD-P of 20-40.

In 2009, largemouth bass CPUE decreased slightly (Table 3) and is still below average and the management objective. All sampled bass were at least three years old (Table 4). PIT tags were placed in all stock length bass to allow future evaluation of aging accuracy, growth rate and longevity. One previously tagged bass was sampled in this year's survey. Mean growth for all age classes exceeds regional, statewide and small lakes and impoundments means and the fish were in excellent condition.

Table 3. Largemouth bass electrofishing CPUE, PSD, and mean Wr for Lake Carthage, Miner County, 2001-2009.

	2001	2002	2003	2004	2005	2006	2007	2008	2009	Mean*
CPUE	9.0		12.5		8.5		9.0		6.0	12.0
PSD	100		8		100		53		100	61
RSD-P	56		8		18		29		70	29
Mean Wr	104		120		111		109		109	110

* 5 years (1999, 2001, 2003, 2005, 2007)

Table 4. Average back-calculated lengths (mm) for each age class of largemouth bass in Lake Carthage, Miner County, 2009.

			Back-calculation Age							
Year Class	Age	N	1	2	3	4	5	6	7	8
2006	3	1	80	255	373					
2005	4	3	111	230	294	337				
2004	5	2	104	203	275	352	386			
2002	7	2	114	248	326	375	403	419	431	
2001	8	1	101	175	266	360	393	417	432	447
2000	9	1	148	232	303	355	405	429	450	476
All Classes		**10**	**110**	**224**	**306**	**356**	**396**	**422**	**438**	**461**
Statewide Mean			96	182	250	305	342			
Region III Mean			111	212	287	347	383			
SLI* Mean			99	183	246	299	332			

*Small Lakes and Impoundments

Black Crappie

Management objective: Maintain a crappie fishery with a trap-net CPUE of at least 15 and PSD of at least 40.

Black crappie CPUE has exhibited a classical cyclic pattern over the last 10 years (Table 5). Their condition is excellent and although growth is slower than statewide and Regional means, it is faster than small lakes and impoundments means (Table 6). Recruitment is consistent, but low. Good condition, reasonable growth, consistent recruitment, and larger fish in the population indicate that the Lake Carthage crappie population is at or near its maximum potential under current conditions.

Table 5. Black crappie trap-net CPUE, PSD, and mean Wr for Lake Carthage, Miner County, 2001-2009.

	2001	2002	2003	2004	2005	2006	2007	2008	2009	Mean*
CPUE	7.4		16.1		7.4		18.5		9.2	11.8
PSD	80		35		66		13		18	53
RSD-P	18		7		34		4		1	13
Mean Wr	113		110		118		128		112	116

* 5 years (1999, 2001, 2003, 2005, 2007)

Table 6. Average back-calculated lengths (mm) for each age class of black crappie in Lake Carthage, Miner County, 2009.

			Back-calculation Age							
Year Class	Age	N	1	2	3	4	5	6	7	8
2008	1	4	70							
2007	2	63	82	137						
2006	3	24	72	137	185					
2005	4	1	86	145	188	219				
All Classes		**92**	**78**	**140**	**187**	**219**				
Statewide Mean			83	147	195	229	249			
Region III Mean			95	167	219	253	274			
SLI* Mean			78	134	180	209	226			

*Small Lakes and Impoundments

Bluegill

Management objective: Maintain a bluegill fishery with a trap-net CPUE of at least 20 and RSD-18 of at least 20.

Bluegill trap-net CPUE remains well below the management objective due to low, but fairly consistent, recruitment (Table 7, Figure 3). Bluegill condition is good (Table 7) but growth is slower than statewide, regional and small lakes and impoundments means (Table 8). Larger bluegills are occasionally produced (2001, 2003) but high turbidity, siltation of spawning habitat and a lack of submerged aquatic vegetation are likely limiting the potential for the fishery to improve beyond what has been observed in the last 10 years.

Table 7. Bluegill trap-net CPUE, PSD, RSD-18, RSD- P, and mean Wr for Lake Carthage, Miner County, 2001-2009.

	2001	2002	2003	2004	2005	2006	2007	2008	2009	Mean*
CPUE	5.5		4.2		65.1		9.0		3.6	18.1
PSD	95		98		32		22		62	68
RSD-18	78		78		10		2		19	43
RSD-P	18		62		8		1		0	19
Mean Wr	109		109		122		104		109	109

* 5 years (1999, 2001, 2003, 2005, 2007)

Table 8. Average back-calculated lengths (mm) for each age class of bluegill in Lake Carthage, Miner County, 2009.

			Back-calculation Age							
Year Class	Age	N	1	2	3	4	5	6	7	8
2008	1	3	87							
2007	2	9	54	111						
2006	3	10	52	117	147					
2005	4	8	52	107	144	174				
2004	5	2	49	100	122	146	169			
2003	6	2	47	95	120	138	152	168		
All Classes		**34**	**57**	**106**	**133**	**153**	**161**	**168**		
Statewide Mean			55	103	141	166	180			
Region III Mean			60	116	157	180	190			
SLI* Mean			53	101	138	163	180			

*Small Lakes and Impoundments

Channel Catfish

Management objective: Maintain a channel catfish fishery with a trap-net CPUE of at least 5.

Channel catfish CPUE decreased significantly since 2007 and is now below the management objective (Table 9). The stocking of 455 adult catfish in 2004 and 2005 was likely responsible for the increase in CPUE seen in 2005. The young fish sampled in 2007 are probably the offspring of the stocked fish (Figure 5). It is uncertain why the catch dropped in 2009. Fewer catfish were observed during electrofishing as well.

Table 9. Channel catfish trap-net CPUE, PSD, RSD-P and mean Wr for Lake Carthage, Miner County, 2001-2009.

	2001	2002	2003	2004	2005	2006	2007	2008	2009	Mean*
CPUE	0.9		6.6		32.3		29.7		2.6	13.9
PSD	--		6		34		80		14	40
RSD-P	--		0		0		0		14	0
Mean Wr	--		92		91		93		82	92

* 5 years (1999, 2001, 2003, 2005, 2007)

Black Bullhead

Management objective: Maintain a bullhead fishery with a trap-net CPUE of no more than 100.

Black bullhead CPUE increased again in 2009 and still exceeds the management objective (Table 9). The bullheads sampled ranged in length from 11-26 cm (4.3-10.2 in) with a mean length of only 181 mm (7.1 in). It is interesting to note that bullhead CPUE was at a 10-year low following the adult catfish stockings in 2004 and 2005.

Table 10. Black bullhead trap-net CPUE, PSD, RSD-P and mean Wr for Lake Carthage, Miner County, 2001-2009.

	2001	2002	2003	2004	2005	2006	2007	2008	2009	Mean*
CPUE	761.0		847		34.1		366.5		684.9	793.6
PSD	5		52		23		0		1	16
RSD-P	0		1		1		0		0	0
Mean Wr	80		95		92		87		85	89

* 5 years (1999, 2001, 2003, 2005, 2007)

All Species

Black bullhead and northern pike CPUE has increased while most of the other fish populations have decreased (Table 11).

Table 11. Trap-net (TN) CPUE for all fish species sampled in Lake Carthage, Miner County, 2001-2009.

Species	2001	2002	2003	2004	2005	2006	2007	2008	2009
COC (TN)	0.1		1.7		17.3		22.4		3.9
WHS (TN)	1.5		9.2		10.4		14.6		1.2
BLB (TN)	761.0		847.0		34.1		366.5		684.9
CCF (TN)	0.9		6.6		32.3		29.7		2.6
NOP (TN)	0.7		0.9		0.1		0.8		1.5
HYB (TN)	--		--		0.3		1.0		0.2
BLG (TN)	5.5		4.5		65.1		9.0		3.6
LMB (TN)	0.1		0.2		0.1		--		--
BLC (TN)	7.4		16.1		7.4		18.5		9.2
YEP (TN)	--		0.1		4.0		0.7		--
WAE (TN)	--		1.7		--		0.1		0.1

COC (Common Carp), WHS (White Sucker), BLB (Black Bullhead), CCF (Channel Catfish), NOP (Northern Pike), HYB (Hybrid Sunfish), BLG (Bluegill), LMB (Largemouth Bass), BLC (Black Crappie), YEP (Yellow Perch), WAE (Walleye)

MANAGEMENT RECOMMENDATIONS

1. Control the black bullhead population by a combination of predator management, commercial fishing and Department removals.

2. Stock advanced-size largemouth bass as needed to supplement limited natural reproduction. Evaluate stocking efforts through marking and periodic electrofishing.

3. Enhance shoreline cover by placing and anchoring trees to the banks of the lake. Conduct habitat projects during low water period of drawdowns. Observe and document fish usage during electrofishing surveys.

Table 12. Stocking record for Lake Carthage, Miner County, 1991-2009.

Year	Number	Species	Size
1991	3,465	Walleye	Lrg. Fingerling
1992	39,000	Largemouth Bass	Med. Fingerling
1993	4,757	Walleye	Lrg. Fingerling
	108	Walleye	Juvenile
1995	10,150	Walleye	Sml. Fingerling
1996	5,000	Walleye	Sml. Fingerling
2002	25,300	Largemouth Bass	Fingerling
2004	225	Channel Catfish	Adult
2005	230	Channel Catfish	Adult
2006	115	Largemouth Bass	Adult
2007	692	Walleye	Adult

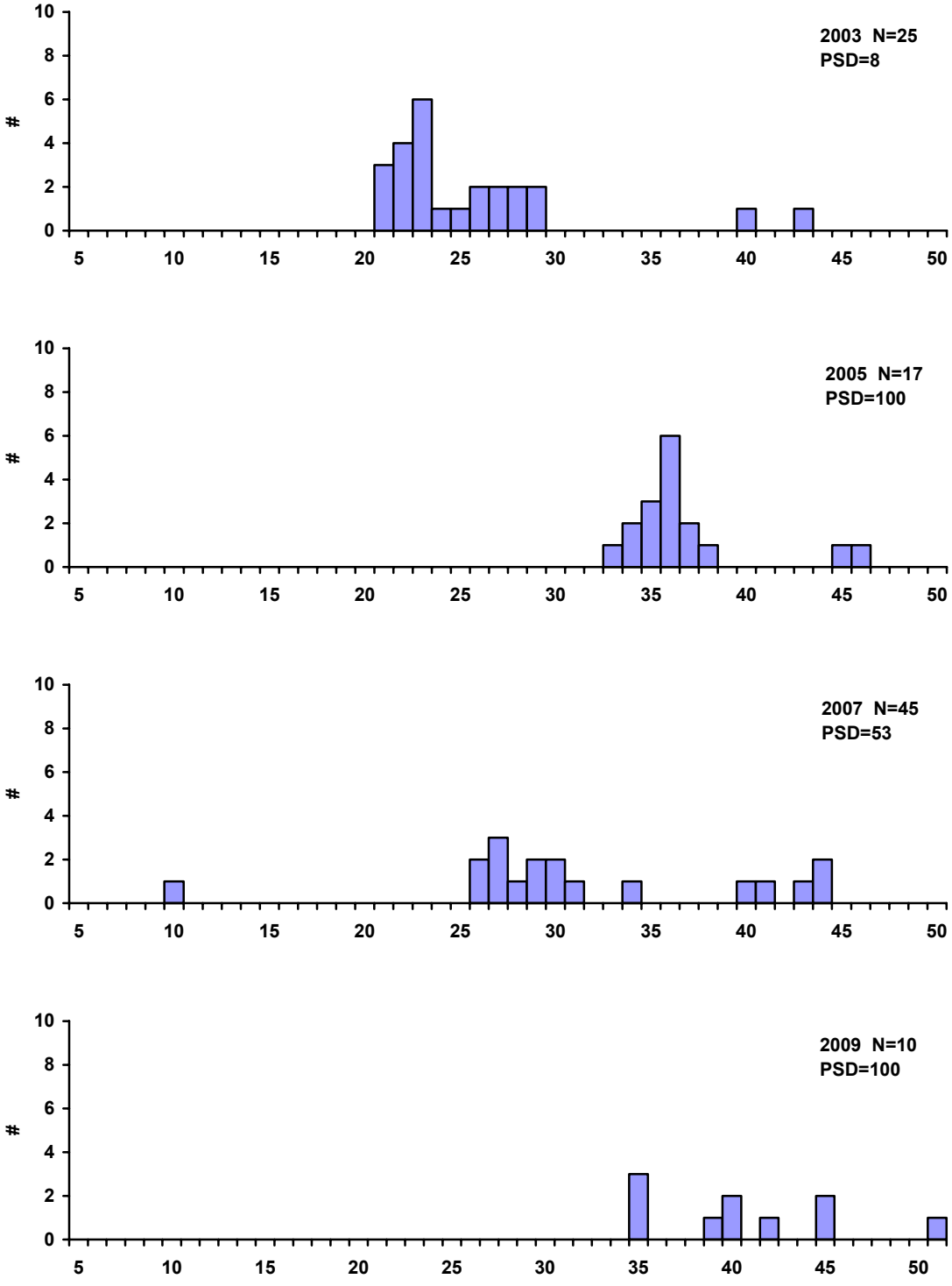

Figure 1. Length frequency histograms for largemouth bass sampled by electrofishing in Lake Carthage, Miner County, 2003, 2005, 2007, and 2009.

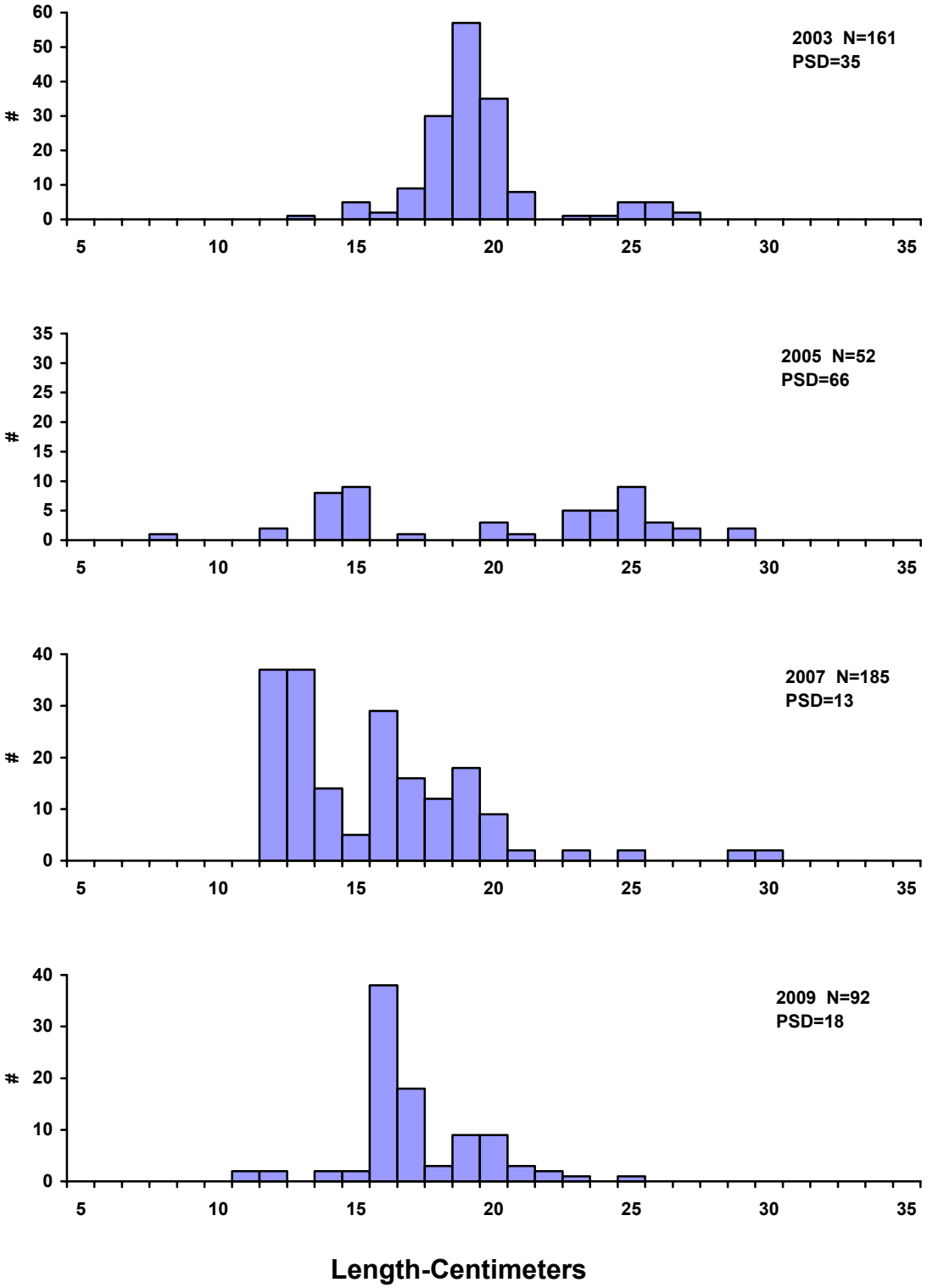

Figure 2. Length frequency histograms for black crappies sampled with trap nets in Lake Carthage, Miner County, 2003, 2005, 2007, and 2009.

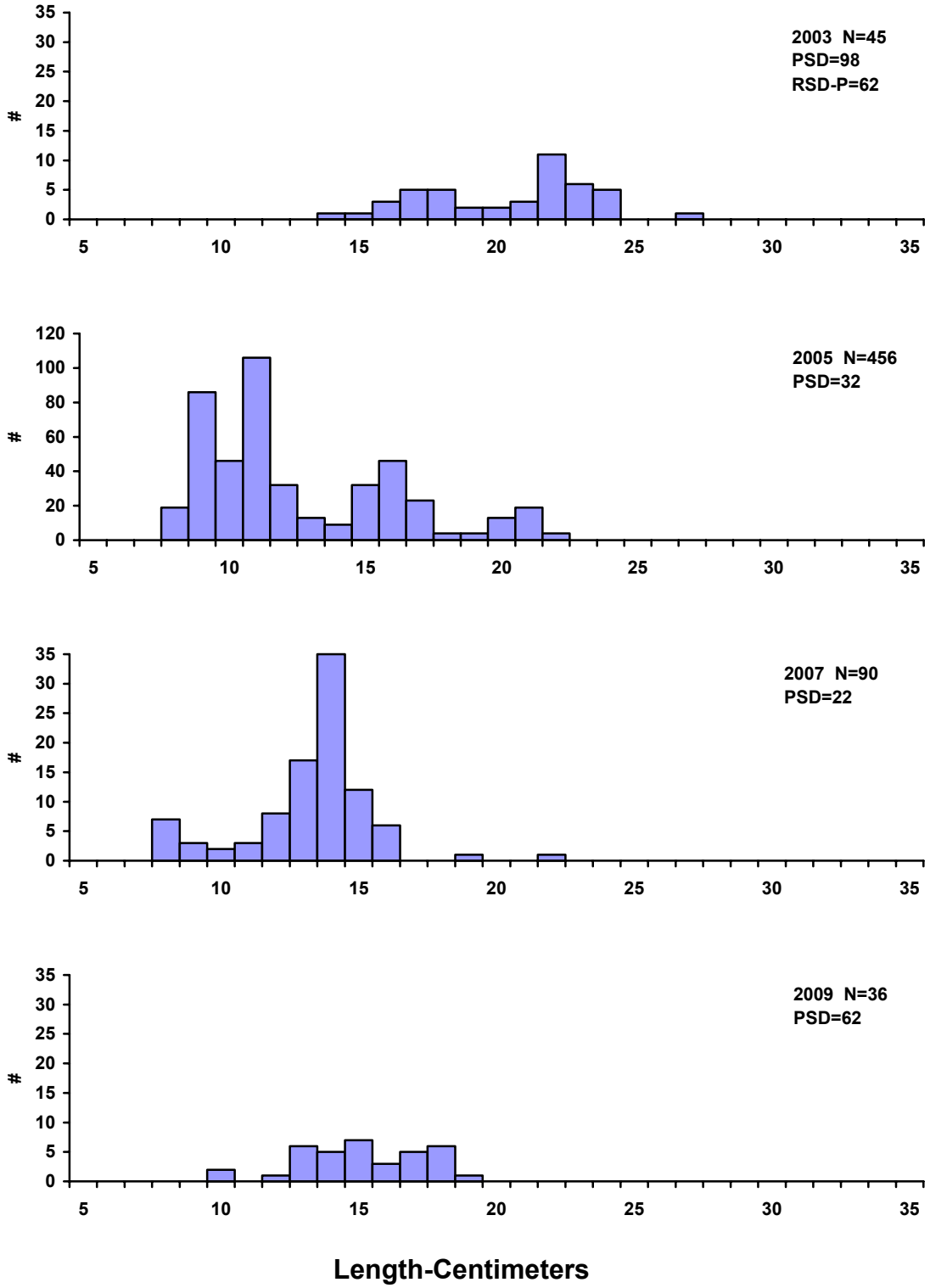

Figure 3. Length frequency histograms for bluegill sampled with trap nets in Lake Carthage, Miner County, 2003, 2005, 2007, and 2009.

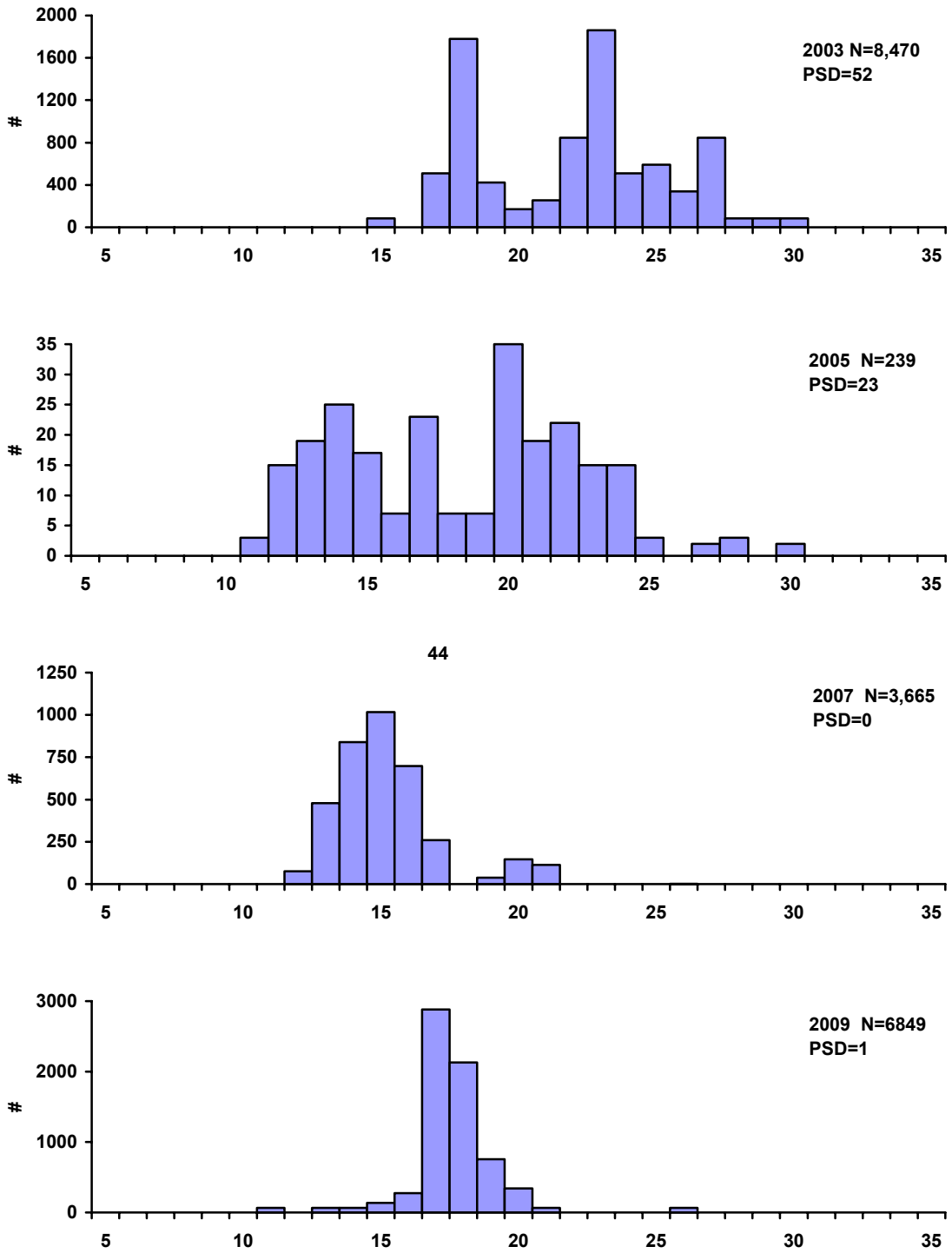

Figure 4. Length frequency histograms for black bullheads sampled with trap nets in Lake Carthage, Miner County, 2003, 2005, 2007, and 2009.

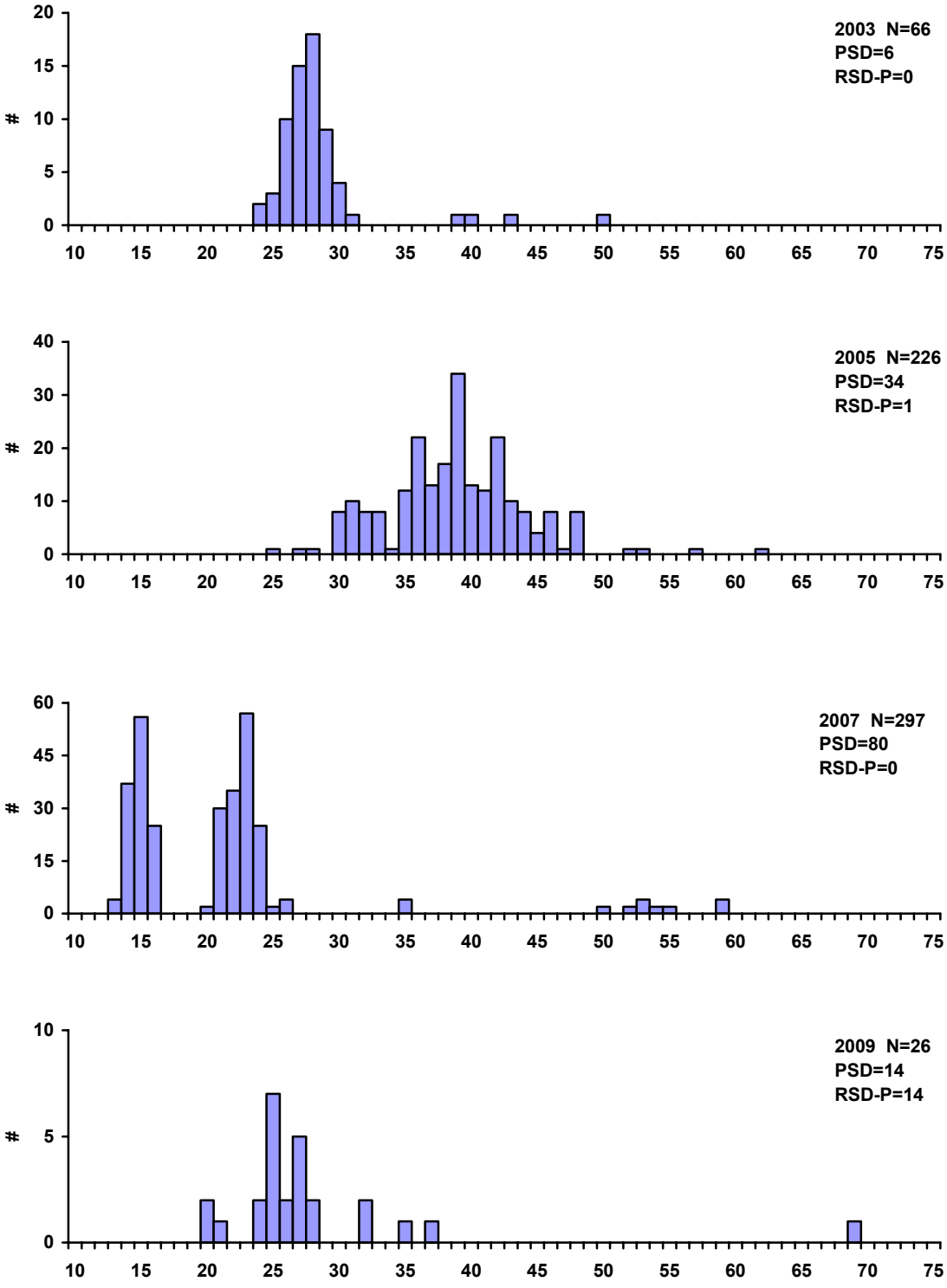

Figure 5. Length frequency histograms for channel catfish sampled with trap nets in Lake Carthage, Miner County, 2003, 2005, 2007, and 2009.

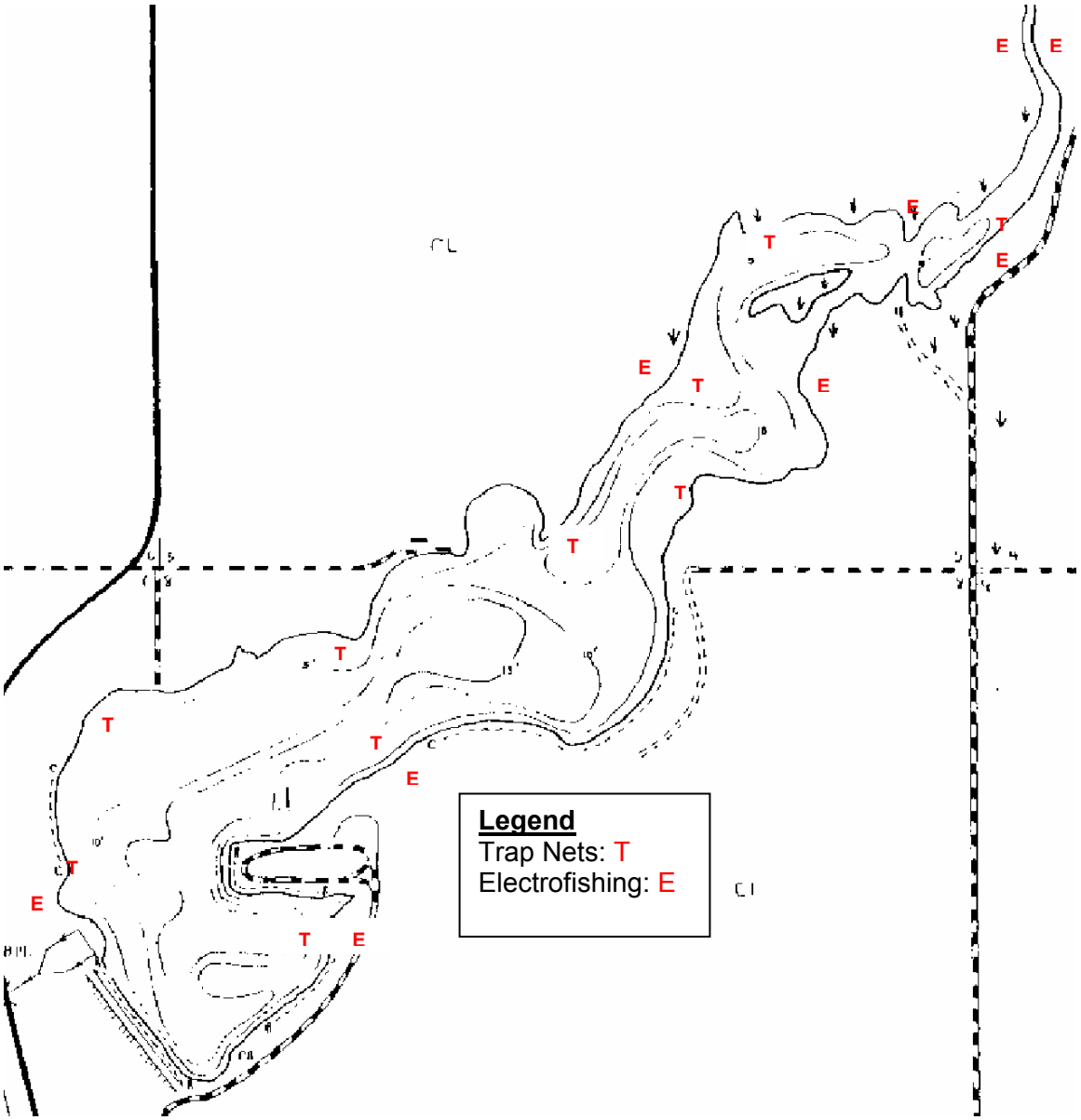

Figure 6. Sampling locations on Lake Carthage, Miner County, 2009.

Appendix A. A brief explanation of catch per unit effort (CPUE), proportional stock density (PSD), relative stock density (RSD) and relative weight (Wr).

Catch Per Unit Effort (CPUE) is the catch of animals in numbers or in weight taken by a defined period of effort. Can refer to trap-net nights of effort, gill-net nights of effort, catch per hour of electrofishing, etc.

Proportional Stock Density (PSD) is calculated by the following formula:

$$PSD = \frac{\text{Number of fish} > \text{quality length}}{\text{Number of fish} \geq \text{stock length}} \times 100$$

Relative Stock Density (RSD-P) is calculated by the following formula:

$$RSD\text{-}P = \frac{\text{Number of fish} > \text{preferred length}}{\text{Number of fish} \geq \text{stock length}} \times 100$$

PSD and RSD-P are unitless and usually calculated to the nearest whole digit.

Size categories for selected species found in Region 3 lake surveys, in centimeters.

Species	Stock	Quality	Preferred	Memorable	Trophy
Walleye	25	38	51	63	76
Sauger	20	30	38	51	63
Yellow perch	13	20	25	30	38
Black crappie	13	20	25	30	38
White crappie	13	20	25	30	38
Bluegill	8	15	20	25	30
Largemouth bass	20	30	38	51	63
Smallmouth bass	18	28	35	43	51
Northern pike	35	53	71	86	112
Channel catfish	28	41	61	71	91
Black bullhead	15	23	30	38	46
Common carp	28	41	53	66	84
Bigmouth buffalo	28	41	53	66	84
Smallmouth buffalo	28	41	53	66	84

For most fish, 30-60 or 40-70 are typical objective ranges for “balanced” populations. Values less than the objective range indicate a population dominated by small fish while values greater than the objective range indicate a population comprised mainly of large fish.

Relative weight (Wr) is a condition index that quantifies fish condition (i.e., how much does a fish weigh for its length). A Wr range of 90-100 is a typical objective for most fish species. When mean Wr values are well below 100 for a size group, problems may exist in food and feeding relationships. When mean Wr values are well above 100 for a size group, fish may not be making the best use of available prey.